Appreciation is expressed to Ralph Blanchfield, Wilhelm Holzapfel and Rudd Valyasevie for their comments on diversification into new value-added products. Should biotechnology development be linked to technological industrialisation of traditional fermentation processes and their marketing globally? The results of biotechnology research will lead to fermented foods that are nutritional and have improved safety attributes.

3. Some Issues Relevant to Developing Countries

- A considerable volume of research into the development and improvement of fermentation processes is currently taking place worldwide. Are the research results from developing countries adequately documented and adequately translated into improved fermentation processes?

- Are the nutritional characteristics (and safety aspects) of fermented foods adequately documented and adequately translated into improved fermentation processes?

- Are the microbial cultures or enzymes adequately translated into improved fermentation processes? Many of the traditional fermentation processes applied in developing countries are very poorly understood, particularly outside the country of origin. An example of this is the production of many fermented foods in developing countries, including lactic acid bacteria, yeasts and fungi used in the production of dairy products (cheese, yogurt, fermented milk), sausages and soy sauce. In many developing countries, the raw food materials produced by the crop, fishery and livestock sectors are fermented to produce saleable products.

2.2 Biotechnology in the production of enzymes

- Genetic technologies have not only improved the efficiency with which enzymes can be produced, but they also provide search methods for high-level gene expression. This technique involves creating large numbers of new enzyme variants by random genetic mutagenesis, principally single base pair changes (site-directed mutagenesis) or multi-base pair changes (random mutagenesis) in the enzyme genes. The advantage of this method is that new enzyme variants can be selected or genetically modified to increase the efficiency with which they can generate the respective enzyme product. In addition, through protein engineering, it is possible to generate novel enzymes with modified structures that are more thermostable, more active or specific to certain substrates.

- Enzymes produced by recombinant microorganisms are currently commercially produced and are widely used in the food industry. For example, the DNA coding for chymosin, an enzyme found in the stomach of calves, that causes milk to clot is a product of recombinant microorganisms and is currently commercially produced and is widely used in cheese manufacture. Other examples of commercialised recombinant enzymes include: (i) rennin, a protein that causes milk to clot in cheese making (Escherichia coli and Kluyveromyces lactis); (ii) xylanase, an enzyme that can break down the backbone of cellulose (Escherichia coli); (iii) amylase, a protein that breaks down starch (Escherichia coli); (iv) phospholipase, an enzyme that can modify the composition of egg yolk (a strain of Bacillus subtilis); and (v) lipase, an enzyme that can modify the composition of egg yolk (a strain of Bacillus subtilis).

- Enzymes produced by recombinant microorganisms can be denatured at temperatures above 42°C. However, certain bacterial enzymes are tolerant to a broader range of temperatures and can work at very high temperatures, which makes them ideal for use in the production of enzymes for the food and beverage industry. In addition, enzymes from recombinant microorganisms are more easily produced than those derived from natural sources.

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2.1.1 Traditional approaches

- Hybridisation has been used in the improvement of yeast strains which are used in the production of beer and wine. The hybridised yeast strains can benefit from the desirable characteristics of the parental yeast strain.

- The use of molecular markers; development of recombinant vaccines and DNA-based methods of disease diagnosis; and the genetic characterisation of microorganisms involved in the production of food fermentation processes are all examples of how biotechnology is being used in the food and beverage industry.

Microarrays allow both plasmid-localised and chromosomal gene transfer (a plasmid is a circular self-replicating non-viral DNA molecule). However, these technologies and other genetic tests allow the characterisation and identification of organisms at the species, subspecies and strain level, depending on the reaction conditions used. The use of combinations of techniques, along with the development of molecular markers for bacterial strains, greatly facilitates understanding of the ecological interactions of microbial strains, their roles, succession, competition and mutualistic relationships.

In this section, we consider some areas in which biotechnology applications in food processing: Can developing countries use biotechnology to improve the production, processing and preservation of foods? What are the ethical considerations of using biotechnology in the food sector? What are the potential benefits and risks of using biotechnology in the food sector?

6. Some Issues Relevant to Developing Countries

- Biotechnology applications in food processing: Can developing countries use biotechnology to improve the production, processing and preservation of foods? What are the ethical considerations of using biotechnology in the food sector? What are the potential benefits and risks of using biotechnology in the food sector?

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